Exploring HBCU Student Academic Self-Efficacy in Online STEM Courses

Lawrence O. Flowers, Assistant Professor of Microbiology, Fayetteville State University, USA

ABSTRACT

Colleges and universities worldwide are actively engaged in the development and application of quality online distance education programs to enhance learning experiences. The current empirical study investigates the self-efficacy of HBCU students enrolled in online and traditional biology and computer science courses using the Survey of Academic Orientations (SAO) academic self-efficacy subscale. Multiple regression analysis revealed that both online students and traditional students in STEM courses demonstrated similar levels of self-efficacy during their academic experiences. Evidence-based implications for improving online pedagogical practices to enhance online student self-efficacy are discussed in the article. Findings from this research study can be utilized by online faculty and distance education professionals to develop approaches to evaluate online learning programs and increase retention rates and academic outcomes in online courses in STEM fields.

INTRODUCTION

Access to online distance education courses and programs has increased significantly in the last decade (Allen & Seaman, 2010). Both traditional college students and non-traditional college students from all academic disciplines are now actively participating in web-based courses. Online courses and degree programs are advantageous to students in many ways. For example, virtual educational environments confer a great deal of flexibility to students and allow students the opportunity to fulfill family, work, social, and civic obligations while obtaining a quality education (Kolowich, 2010). The ever-expanding diversity of online course offerings and academic programs at the post-secondary level offer adults a variety of different scholarly options. Moreover, effectively designed online courses allow instructors the opportunity to design meaningful interventions designed to accommodate distinctive student learning styles (Zapalska & Brozik, 2006). Further, it is clear that increasing online distance education initiatives is an effective strategy to educate a larger percentage of the world’s population.

Despite the exponential increase in online courses and programs around the country, there exists considerable faculty and administration opposition to online program development and expansion (WCET, 2010). Further, there is a substantial lag in the amount of fully online science, technology, engineering and mathematics (STEM) courses compared to online courses in the humanities due to a variety of reasons. Additionally, attrition and drop rates are typically higher for online courses than for traditional courses, probably due to student isolation, locus of control, and technology problems (Parker, 1999; Willging & Johnson, 2009). Using an electronic survey and regression analysis Willging and Johnson (2009) compared factors that affect dropout rates among online students enrolled in an online master’s degree program in Global Human Resource Development. Their results showed that demographic factors had little predictive value regarding attrition in online courses, while self-efficacy in academic success and technology utilization played a role in mediating successful online experiences. From these and other
studies it is clear that self-efficacy is a major factor in online education and paves the way for the development of strategies to counteract the effects of negative self-efficacy in higher education.

Bandura (1995) noted that self-efficacy is “the belief in one’s capabilities to organize and execute the courses of action required to manage prospective situations” (p. 2). Self-belief in one’s academic abilities is facilitated by four factors: mastery experiences, social modeling, social persuasion, and psychological responses (Bandura, 1997). Historically, academic self-efficacy has been an extremely important issue in higher education. Many educational scholars have contributed a large amount of research on the topic of self-efficacy as it relates to students’ academic performance, college student retention, and career explorations (Bandura, 1997; DeWitz, Woolsey, & Walsh, 2009; Flowers, Moore, Flowers, & Clarke, 2011; Vuong, Brown-Welty, & Tracz, 2010; Zajacova, Lynch, & Espenshade, 2005). For example, in their review of the self-efficacy research literature Pascarella and Terezini (1991) noted that self-efficacy plays a positive role in influencing performance in college. Moreover, Zajacova, Lynch, & Espenshade (2005) reported that academic self-efficacy is a strong indicator of potential academic success. Of notable interest to the current research study is the work done by Engle and Tinto (2008) that examines low-income, first generation students and other underrepresented populations. In their investigation Engle and Tinto (2008) identified several factors that may promote college access and success for first-generation minority students. Analysis of their investigation revealed that self-efficacy plays an important role in producing positive academic outcomes for first-generation college students. Additionally, numerous studies have documented the diverse issues associated with poor academic performance and soaring drop-out rates among minority students (Koenig, 2009; Smedley, Myers & Harrell, 1993). In terms of STEM disciplines, research supports the view that increased self-efficacy can lead to high academic achievement among students in science courses (Britner & Pajares, 2006). While academic self-efficacy has and continues to garner a significant amount of coverage in educational research databases the issue of self-efficacy as it relates to online distance learning in STEM disciplines has received far less attention. For the current study, online self-efficacy in STEM courses is viewed as the self-confidence a student has in his or her ability to perform at a high level during a web-based STEM course. That self-assurance must extend not only to the successful completion of online exams, quizzes, and discussion boards but also to virtual laboratories that focus on specific problem solving and critical thinking skills.

**METHODOLOGY**

**Variables**

The Academic Self-Efficacy scale from the Survey of Academic Orientations served as the dependent variable in the current study (Beck & Davidson, 2001; Davidson & Beck, 2006; Davidson, Beck, & Silver, 1999). Course enrollment served as the independent variable for the study. Course enrollment refers to whether a student was enrolled in an online course in STEM or a traditional (face-to-face) course in STEM. As previously described the Survey of Academic Orientations is a 36-item, Likert-type scale (5 = strongly agree to 1 = strongly disagree). College students were asked to rate the extent to which each statement described their attitudes, perceptions, and/or behaviors. Academic Self-Efficacy is a six-item scale measuring the confidence in one’s academic ability to become proficient in academic tasks and assignments and achieve one’s scholastic goals (Davidson, Bromfield, & Beck, 2007). Table 1 illustrates the six-item academic self-efficacy scale. More detailed information about the research study variables are shown in Table 2.
Procedures

The Survey of Academic Orientations’ Academic Self-Efficacy scale was administered to college students enrolled in both an online and traditional STEM course to determine students’ beliefs in their academic ability to accomplish their academic goals. Ordinary least squares regression was the principal data analytic tool used in the current study. Specifically, the Academic Self-Efficacy scale from the Survey of Academic Orientations was regressed on the independent variable and the entire set of control variables to estimate the differences in self-efficacy for students taking online STEM courses versus traditional STEM courses. Next, effect sizes were computed by dividing the regression coefficient by the pooled standard deviation of the outcome measure.

RESULTS

Table 1 and Table 2 show the Academic Self-Efficacy 6-item subscale and variables (independent variable, dependent variable, control variables) used in the empirical study. The 6-item subscale is designed to evaluate an individual student’s accomplishment orientations. Moreover, it is intended to determine a student’s perception regarding their ability to succeed academically (Vuong, Brown-Welty, & Tracz, 2010). The control variables consisted of both categorical and interval-scaled variables (age, gender, grade point average, year in school, residence status, hours spent studying per week, hours worked on- and off-campus) employed to effectively assess the relationship between the independent variable and dependent variables. Table 3 provides data regarding the effect of participating in an online STEM course compared to participating in a traditional STEM course on self-efficacy.

While students enrolled in a STEM online course reported higher scores on the Survey of Academic Orientations academic self-efficacy subscale ($B = .152$) when compared to traditional STEM students, statistical analysis revealed that the differences were not significant. Based on the results the investigator is precluded to definitively suggest that online STEM students have higher self-efficacy than traditional STEM students. The results suggest that online STEM HBCU students’ self-efficacy may be similar to that of traditional STEM HBCU students.

DISCUSSION AND IMPLICATIONS

While there is a dearth of empirical research studies that investigate self-efficacy and online learning in STEM disciplines at post-secondary institutions, it is clear from the literature that a student’s confidence in their academic capabilities and Internet-based technology comprehension is critical to their online course success (Wang, 2011). There are a number of approaches that online faculty and college administrators can employ to increase students’ self-confidence in online courses in STEM such as measuring students’ online preparedness and designing a complete instructional approach to minimize student weaknesses regarding technology usage and content comprehension. To assess students’ readiness to utilize educational technology and achieve success in computer-mediated education in STEM, a pre-online course survey could be administered. The readiness survey could contain questions designed to explore important barriers to success in web-based courses such as educational technology skills, learning styles, study skills, collaboration skills, time-management skills, number of previous STEM courses, number of previous online courses, and communication skills. Student results would provide a wealth of useful information for higher education institution administrators, online education offices, and online faculty tasked with the designing and implementing high quality online courses. Moreover, the pre-online
course survey could also be administered during the mid-way point or at the end of a particular online course so that student progress in specific areas could be monitored. If utilized during midterms the results of the survey could be used to provide a formative assessment for the course. If utilized at the end of a course survey results could provide beneficial summative data for future course improvements.

As previously noted students in online science and engineering courses tended to prefer instructional environments that had more structure than students who took traditional courses. Thus, designing assignments and online activities with supportive details is a strategy that will not only fulfill an online student’s need for structure in an online course but may also instill self-confidence in STEM students by reassuring them that all of the necessary information for successful completion of online assignments is readily accessible. An equally effective instructional strategy is the use of rubrics for all course assignments. A rubric is a carefully designed evaluation tool that lists detailed criteria for grading assignments. Previous research has demonstrated that the use of a rubric in an undergraduate course had a positive impact on student academic performance (Howell, 2011). By including rubrics online faculty can maximize student success. Based on experiences as an online biology instructor, students become frustrated in online courses in which assignment instructions have not been adequately explained. The initial frustration affects student self-confidence and leads to high drop-out rates.

Instilling self-confidence in online students can also be mediated by assigning quick, manageable online activities (e.g., essays, quizzes) during the first few weeks of an online course. Completion of the “short” assignments early in the course will enhance the confidence of apprehensive students. This strategy underscores the importance of early successes as a means of transforming negative self-efficacy into positive academic self-efficacy in online courses. Additionally, the creation and maintenance of social presence (Aragon, 2003) in the online environment can decrease transactional distance (Moore, 1997) and boost self-efficacy. Increasing academic confidence in online courses can also be mediated by fully engaging students. Student engagement in the online environment is a challenging endeavor and involves several factors. For example, online student engagement is mediated by the development of a highly structured learning environment in which students are able to easily access exciting and interesting course content.

### Table 1: Academic Self-Efficacy

<table>
<thead>
<tr>
<th>Academic Efficacy Subscale</th>
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<tr>
<td>1. I sometimes wonder if I am really college material.</td>
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<td>2. Anytime that I really need a good grade on a test, I can get it.</td>
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<td>3. Test anxiety lowers my grades a lot.</td>
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<td>4. Sometimes I feel unaware of how to get good grades.</td>
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<td>5. I am pretty good at guessing the questions on tests beforehand.</td>
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<tr>
<td>6. I worry a great deal that I may not get the grade I need in a class.</td>
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### Table 2: Research Variables

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<tr>
<th>Part A: Independent Variable</th>
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<td>Course Enrollment: A categorical variable was coded: 1 = Enrolled in an online STEM course; 0 = Enrolled in a traditional STEM course</td>
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<th>Part B: Dependent Variable</th>
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<tr>
<td>Academic Self-Efficacy: Six-item scale measuring the confidence in one’s academic ability to become proficient in academic tasks and assignments and achieve one’s scholastic goals.</td>
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<th>Part C: Control Variables</th>
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<td>Age: A categorical variable based on a self-reported measure of the respondent’s age was coded: 1 = 18 or younger; 2 = 19-21; 3 = 22-25; 4 = 26-35; 5 = 36 or older.</td>
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Gender: A categorical variable was coded: 1 = female, 0 = male.
Grade Point Average: A categorical variable based on a respondent’s self-reported grade point average was coded: 1 = A; 2 = A, B+; 3 = B; 4 = B-, C+; 5 = C, C-, or lower.
Year in School: A categorical variable based on a student’s year in school was coded: 1 = Freshman; 2 = Sophomore; 3 = Junior; 4 = Senior.
Residence Status: A categorical variable was coded: 1 = live on-campus; 0 = live off-campus.
Hours Spent Studying Per Week: An interval-scaled variable based on a student’s self-report of the number of hours spent studying per week was coded: 1 = 0; 2 = 1-5; 3 = 6-10; 4 = 11-15; 5 = 16-20; 6 = 21-25; 7 = 26-30; 8 = more than 30.
Hours Worked On- and Off-Campus: An interval-scaled variable based on a student’s self-report of the number of hours they worked on- and off-campus per week was coded: 1 = 0; 2 = 1-5; 3 = 6-10; 4 = 11-15; 5 = 16-20; 6 = 21-25; 7 = 26-30; 8 = more than 30.

Table 3: Regression Summary for Academic Self-Efficacy

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<tr>
<th>Dependent Variable</th>
<th>Regression Coefficient</th>
<th>R²</th>
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<tbody>
<tr>
<td>Academic Self-Efficacy</td>
<td>.152*</td>
<td>.013</td>
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</table>

*Statistically controlling for age; gender; grade point average; year in school; residence status; hours spent studying per week; and hours spent working on-campus and off-campus per week.
*p > .01

The use of collaborative assignments and carefully planned discussion boards to engage students is another strategy to increase a student’s participation in the learning process. Enhanced instructor contact with students through the utilization of e-mail, chat sessions, and constructive feedback will also improve student engagement and self-efficacy. The use of carefully constructed e-mails to students who do not adequately participate in the online course is an effective strategy to reduce attrition rates in online courses. Online instructors are encouraged to actively monitor student online activity indicators found in content management systems such as the Performance Dashboard in Blackboard which presents valuable information regarding student activity during the academic semester. Moreover, the application of interactive, collaborative online assignments early in the course will promote a more meaningful learning experience for students and confer student confidence. Prior to initiation of collaborative activities it is very important for the instructor to create an online atmosphere that promotes positive student interactivity so that students feel comfortable working together. A detailed rubric as well as explicit instructions for completing the assignment must accompany the collaborative assignment. Equally important in the assignment introduction is the inclusion of information that explains the educational (e.g., critical thinking skills) and professional (e.g., team-building) benefits of participating and completing the online collaborative assignment. Additional evidence-based instructional strategies that seek to increase online student self-efficacy are needed to reduce dropout rates and improve academic outcomes.

FUTURE RESEARCH

Prospective research studies should employ the use of additional quantitative surveys designed to measure different aspects of student self-efficacy enrolled in hybrid and web-enhanced courses in science.
and engineering. Additionally, carefully designed qualitative studies involving STEM students enrolled in traditional and online courses will more accurately investigate differences in perceived confidence of academic success. Moreover, mixed method empirical studies investigating online STEM faculty may lead to the development of novel instructional approaches that enhance student academic outcomes in STEM disciplines.

Finally, the reason for the observed data may reflect the survey instrument employed. The Survey of Academic Orientations is designed to address global concerns regarding academic self-efficacy and was not constructed to specifically measure self-efficacy regarding online courses in STEM. The utilization of a STEM-specific measure of self-efficacy may be needed to generate more accurate, significant results. It is clear that additional research efforts are needed to carefully elucidate specific factors that influence positive self-efficacy regarding online learning in STEM.

REFERENCES


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